

December 26, 2002

Scott Compton, Regional Manager
Jan Mack, Water resource Specialist
DNRC Water Resources, Bozeman Regional Office
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Dear Scott and Jan:

Enclosed is a short report presenting flow data collected on Mill Creek during the 2002 field season. Five measurement runs were conducted on the dewatered reach of Mill Creek. The percent of natural streamflow losses occurring varies with the amount of inflow into the study reach and can be dependent on the time of day measurements were taken. Natural losses quantified during August ranged between 40 and 60%.

I plan on attending the meeting with FWP in Livingston on January 23 to explain the results of this work. Please let me know if you have questions or comments.

Sincerely,

Mike Roberts
Hydrologist
DNRC – Water Management Bureau

cc. Kathleen Williams, MDFWP

The data presented below were collected to quantify instream flow losses in Mill Creek near Pray Montana. Mill Creek drains westward out to the Absaroka Range, into the Paradise Valley where it contributes flow to the Yellowstone River. The study reach in this report, hereupon known as lower Mill Creek, is defined as Mill Creek between the East River Road (0.5 miles upstream from mouth) and the bridge crossing at stream mile 5.6. Within this 5-mile reach, four active irrigation diversions exist (Figure 1). Surface flow losses in the lower Mill Creek can be attributed to irrigation diversion and channel seepage.

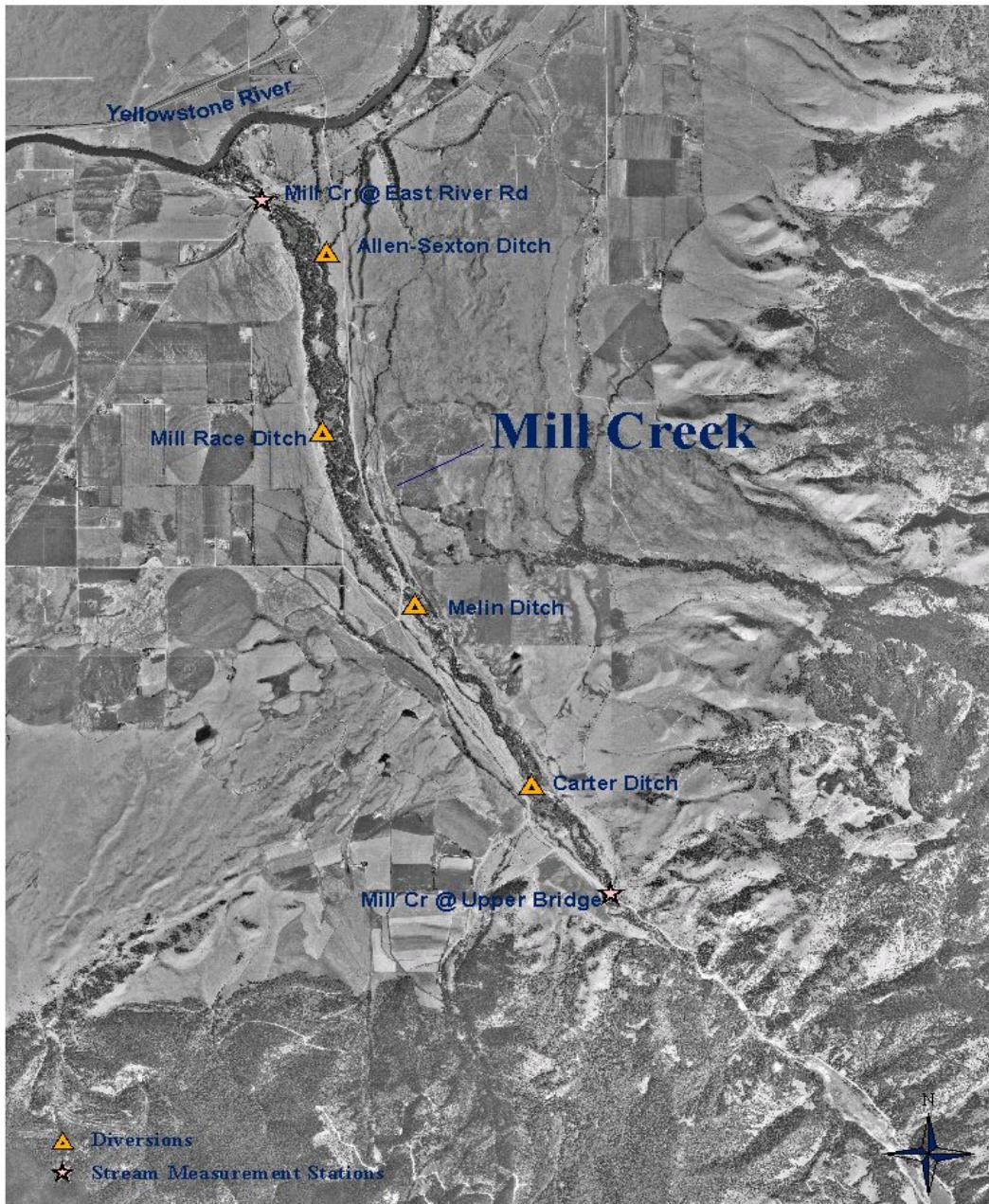


Figure 1. Mill Creek Site Map

Methods

To determine the amount of natural flow loss occurring in lower Mill Creek, synoptic flow measurement runs were conducted. Quantifying these losses requires stream flow measurements taken at the study reach inflow, outflow, and all diversions between the two. Losses are determined using the following equation:

$$\text{Natural Loss} = (\text{Outflow-Inflow}) + \text{diversions}$$

Inflow was measured at the upper boundary of the study reach (upper bridge) and outflow was measured at the East River Road. Diversions between these two points include:

Carter Ditch
Melin Ditch

Allen-Sexton Ditch
Mill Race Ditch

Results

Five synoptic runs were conducted during the 2002 water year. Instream channel losses ranged from 13.1% to 59.2% (Figure 2). Generally, as inflows decrease, the percentage

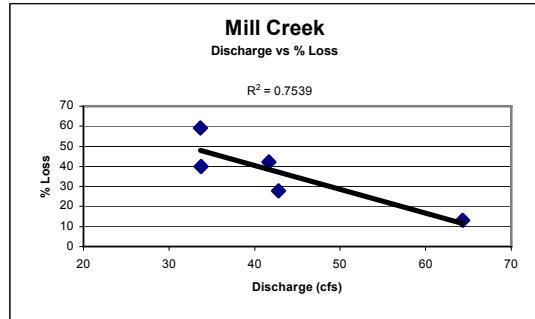
Figure 2. Mill Creek Discharge Measurements (cfs)

Standard USGS Methodology (20 meas., 40sec)

	11/15/01	5/3/02	7/19/2002	8/8/2002	8/9/2002
Mill Creek @ upper bridge	41.7	42.8	64.3	33.7	33.8
Carter Ditch	5.8	3.4	3.8	1.6	1.6
Melin Ditch	0.5	2.0	6.4	4.2	4.2
Mill Race Ditch			2.1	2.0	2.0
Allen-Sexton Ditch	0	0	26.6	8.7	9.6
Mill Creek @ East River Rd	20.5	26.9	22.1	7.0	9.8
<i>total diverted (cfs) =</i>	6.3	5.4	38.9	16.5	17.4
<i>total diverted (%) =</i>	15.2	12.7	60.5	49.0	51.4
<i>net natural loss (cfs) =</i>	-14.9	-10.4	-3.3	-10.2	-6.6
<i>natural loss (%)[*] =</i>	42.1	27.9	13.1	59.2	40.0

*natural loss % expressed as percentage of inflow minus diversions

of loss (or gain) in stream channel increases. This relationship, which was observed in Mill Creek (Figure 3), is consistent with other channel gain/loss studies conducted by DNRC.



All measurements taken at the East River Road site were below 30 cfs, with two relatively low measurements (<10 cfs) taken on consecutive days, August 8 and 9. The August 8 measurement was conducted from 1100 hrs to 1500 hrs. The August 9 measurement was conducted between 0800 and 1200 hrs. It is likely the difference

between the natural losses on these two days, 59% versus 40%, can be attributed to diurnal fluctuations in streamflow as a function of phreatophyte water use. On small streams with abundant riparian vegetation, water levels tend to rise in the evening and continue to rise into mid-morning when plants are not requiring as much water, then, water levels decline into the afternoon when plants are maximizing their water uptake in the heat of the day.

Based on the data presented, natural flow loss in lower Mill Creek in spring and early summer was below 30%. In August, when irrigation demand was high and instream flows low, the percentage of loss was approximately 40 to 60% depending on the time of day.